Using immersive technologies to improve user engagement in sensory testing

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Abstract

Failed product launches are the source of significant financial losses for many food and beverage companies. It is believed that consumer data collected from sensory testing are poor in quality and contribute to product failure by providing companies with information that is unreliable and misleading. To improve quality of consumer data, a study was designed to increase user engagement during testing with the use of immersive technology. Subjects tasted coffee samples and completed an engagement survey in both a traditional sensory testing environment and a virtual environment designed to mimic a coffee shop. Results from the engagement surveys show that seven out of the eight dimensions assessing engagement were positively influenced by the virtual environment. The dimensions of environmental aesthetics, involvement, immersion, sensory and realism factors all yielded significantly more positive scores in the virtual environment than in the traditional sensory booth. The combined total engagement score for the virtual environment was also significantly higher than the sensory booth score, suggesting that the virtual environment is more engaging. If further testing shows the data from virtual environments are also reliable, this technology can be applied to commercial sensory testing to guide more successful and cost efficient product development.

Introduction

Food and beverage companies use data from sensory testing to form predictions about consumer desires and to provide feedback on new products. Sensory experiments are traditionally conducted in controlled environments, often in small personal booths equipped with computer screens for data acquisition and windows for sample delivery. While this simple design is ideal for the control of non-product bias, it is predicted that it allows subjects to become bored and lose focus during testing, affecting the quality of their responses. The information collected is neither predictable nor reliable, and likely contributes to the high rate of failure for product launches (Simons 2013) estimated at around 60-85% in the grocery sector (Costa and Jongen 2010; Redmond 1995).

Immersive technologies, such as virtual reality, provide audio, visual, and olfactory context that is lacking in traditional sensory booths. The use of this technology as a means to enhance the quality of data from consumer testing is supported by research suggesting a positive relationship between engagement and user performance (Witmer and Singer 1998). Engagement in these studies has been

assessed in virtual and interactive environments using surveys designed to score factors of engagement and presence, such as immersion, involvement and realism.

Hypothesis

A testing environment that is engaging can be created through the use of immersive technology.

Purpose and Research Objectives

The study is being conducted to determine if subjects become more engaged during sensory testing when environmental context is introduced to the testing environment. The objective of this study is to compare the level of engagement observed in subjects performing a task in both traditional sensory and virtual reality environments.

Methods and Materials

Participants

Thirteen subjects who drank black coffee in a coffee shop at least once a week were recruited for the study. Most subjects were in the range of 18-25 years old.

Procedure

Each subject was asked to taste five coffee samples and complete an engagement survey once in a traditional sensory booth and once in a virtual reality booth. The study was a within subjects design, whereby all subjects were exposed to all treatments (in this case, both virtual and traditional testing environments). The study was also a randomized crossover study, whereby subjects saw both treatments sequentially in a random order. Testing in each environment lasted about 5-10 minutes. Including sample preparation time for coffee tasting, total testing time was around 15-25 minutes per subject.

Traditional sensory booth

The traditional booth (image 1) was similar in design to commercial sensory booths, equipped with a sample window and red light for color masking.

Image 1. Traditional sensory booth

Virtual reality booth

The virtual reality booth was equipped with speakers and nine 48” monitors which played the audio and video recorded from a local coffee shop. Sound and video were

controlled by a desktop computer located in an adjacent room. Video was shot at 30 fps at 1080 x 1920 resolution and recorded using a Canon 60D camera. Audio was recorded by a Zoom h4n handy recorder. Additionally, cinnamon roll aroma provided by Givaudan was emitted into the room through an aromatizer.

Image 2a-b. Virtual reality booth

Engagement survey

The engagement survey was designed from two validated scales used to assess engagement and presence in interactive and virtual environments (O'Brien and Toms 2010; Witmer and Singer 1998). The compiled survey assessed eight dimensions of engagement as defined in the two previous studies: usability, environmental aesthetics, novelty, involvement, immersion, sensory factors, distraction factors, and realism factors. The first five dimensions were assessed using a bipolar Likert scale with scores ranging from -2 to +2 (figure 1). The last three dimensions were assessed using a unipolar scale scored from 0-6 (figure 2). The survey questions assigned to each dimension can be found in figure 3. Scores collected from these eight dimensions were weighted, normalized, and combined to produce a total engagement score. These results were analyzed by running a 2-way ANOVA to test for statistical significance between scores.

Figure 1. Likert scale (adapted from O'Brien and Toms 2010) for measurement of usability, environmental aesthetics, novelty, involvement and immersion.

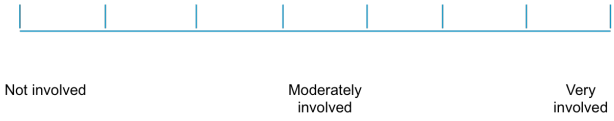

Figure 2. Unipolar scale (adapted from Witmer and Singer 1998) for measurement of sensory, distraction and realism factors.

Dimension	Question
Usability	The testing environment assisted in my evaluations of the samples.
Environmental Aesthetics	The testing environment was appealing.
	The testing environment engaged my senses.
Novelty	The testing environment inticed my curiosity.
	The testing environment distracted me.
Involvement	The testing experience was boring.
	The testing experience was fun.
	I was engaged in the sensory task I performed.
Immersion	I felt like I was in a coffee house.
	I lost track of time.
Sensory Factors	How completely were all of your senses engaged by the testing environment?
	How much did the visual aspects of the testing environment involve you?
	How much did the auditory aspects of the testing environment involve you?
	How much did the olfactory aspects of the testing environment involve you?
Distraction Factors	How aware were you of events occuring in the real world around you?
	How quickly did you adjust to the testing environment experience?
	How much did the testing environment interfere or distract you from perfoming your sensory evaluation?
Realism Factors	How disconnected did you feel from the testing environment?
	How much did your experiences in the testing environment seem consistent with your real-world experiences?
	How completely did you feel immersed in the testing environment?
	How involved were you in the testing environment experience?

Figure 3. Dimensions and corresponding questions from user engagement survey derived from surveys assessing engagement and presence (Witmer 1998; O'Brien 2010)

Results and Discussion

Scores from the engagement surveys can be observed in figure 4. All dimensions of engagement were positively influenced by the virtual reality environment except for the dimension "distraction factors". Both environments had similar scores for distraction, indicating that the virtual environment is no more distracting than the sensory booth. Scores for dimensions of environmental aesthetics, involvement, immersion, sensory and realism factors were all significantly more positive in the virtual environment than in the traditional booth.

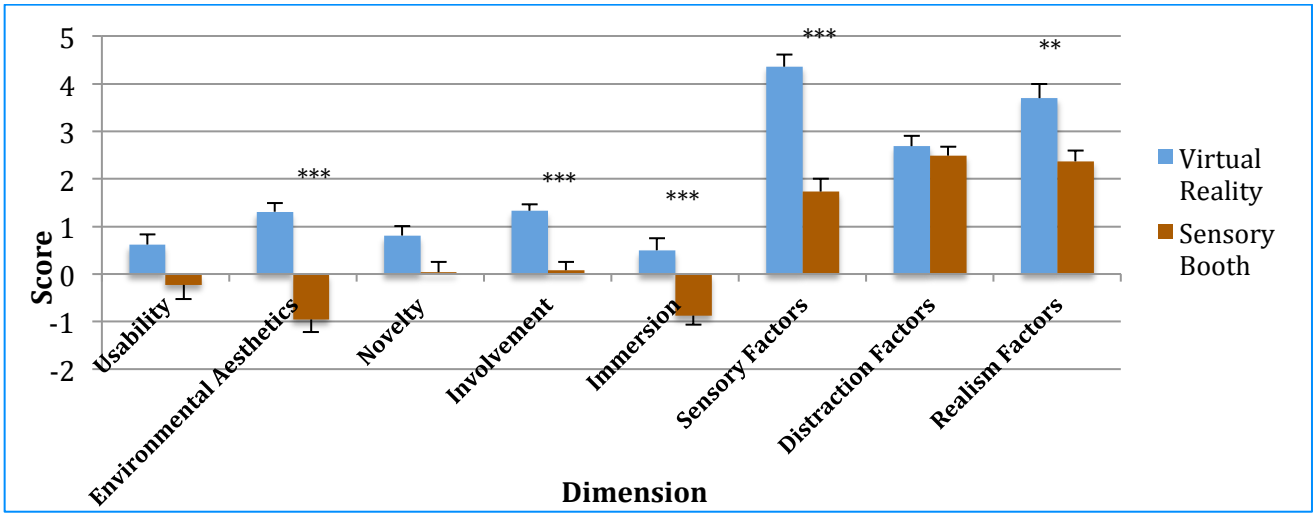

Figure 4. Derived scores for eight dimensions analyzed in the user engagement survey in the virtual reality and traditional sensory booth environments n= 13.

**p<0.01

***p<0.001

The combined total engagement score (figure 5) was significantly more positive for the virtual reality environment than for the traditional sensory booth.

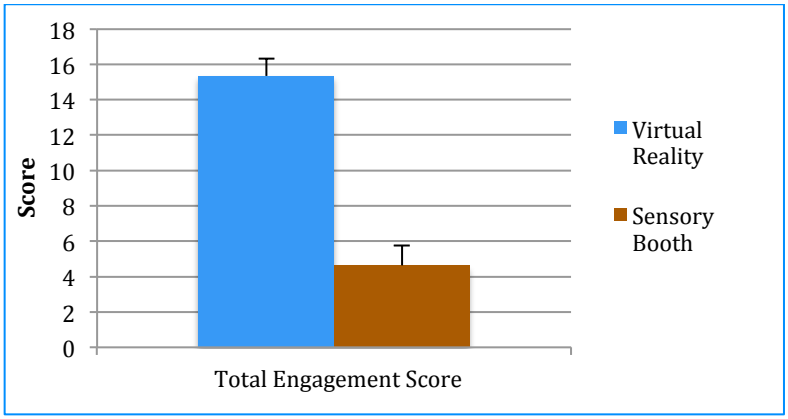

Figure 5. Derived scores for total engagement $p<0.001$.

Conclusion

All dimensions except for distraction were positively influenced by the virtual environment. The scores for the dimensions of environmental aesthetics, involvement, immersion, sensory factors, and realism factors were all significantly more positive in the virtual environment than in the traditional booth. The derived engagement score for the virtual reality environment was significantly more positive than the sensory booth score. The data suggests that the virtual reality technology can successfully provide an engaging testing environment.

Increasing the sample size as well as widening the age range of participants would be important to explore in future studies to determine if engagement is still significantly more positive in the virtual environment than in the traditional sensory booth. It is hypothesized that older age groups may score negatively for factors such as realism and usability due to the distraction by audio and visual stimuli.

Future studies may also explore the reliability of consumer data in a test-retest scenario whereby scores from preference testing will be compared from identical tests taken over a period of 3-6 months. Ultimately, information from these tests can be used to structure a more effective and informative product development process and increase the success rate of future product launches.

References

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